

ORIGINAL RESEARCH

Research on the Effectiveness of the Training of Nosocomial Infection Control Specialist Nurses under the Background of the New Crown Epidemic Based on Competence-based Theory

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ABSTRACT

Background • Coronavirus disease 2019 is highly contagious and has the potential to cause nosocomial infections, has placed a strong pressure on worldwide healthcare systems over the last years. Nosocomial infection has many influencing factors, among which the unreasonable operation of nurses accounts for 30.0%-50.0%. Therefore, strengthening the professional skill training of nurses is of great significance in reducing the nosocomial infection rate.

Objective • This research aimed to explore the effectiveness of the training of nosocomial infection control on the competencies of specialist nurses under the background of the new crown epidemic based on competency-based theory.

Design • This was a retrospective study.

Setting • This study was performed in Dongfang Hospital, Affiliated to Tongji University.

Participants • A total of 84 key nurses, each of them recommended by one department from June 2020 to June 2021, were chosen as study subjects, and they could actively participate in the training.

Interventions • Nurses received systematic and standardized training based on competency-based theory under the background of coronavirus disease 2019, including focus group meeting, training of core emergency capability, teaching training and contingency plan for COVID-19 infection.

Primary Outcome Measures • (1) core competence (2) job fit (3) core emergency response for major infectious diseases, and (4) nurses'

satisfaction. All these primary outcomes can reflect the competencies of specialist nurses after training.

Results • The scores in critical thinking and scientific research, clinical nursing, ethics and legal practice, professional development, education consulting and professional knowledge, professional skills, comprehensive quality, and professional ability of nurses training were higher than those before ($P = .000$). After training, the scores in relevant matters needing attention (international rescue, bioterrorist attacks, and infectious disease emergencies after natural disasters), filling in the People's Republic of China Infectious Disease Report Card, and the scope of reporting infectious disease emergencies were all higher than before ($P = .000$). All nurses had relatively high satisfaction with the curriculum setting and assessment form, with satisfaction of 100.0%, followed by training duration, with satisfaction of 92.86%.

Conclusion • Under the background of coronavirus disease 2019, based on competence-based theory, training of nosocomial infection control specialist nurses could improve their core competence, job fit, and core emergency response capabilities, with high satisfaction. Under the background of the normalization of the prevention and control of the novel coronavirus pneumonia epidemic, the training model based on competence-based theory of nurses is worth promoting. (*Altern Ther Health Med*. [E-pub ahead of print.])

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INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic, caused by severe acute respiratory disease coronavirus 2 (SARS-CoV-2), has led to millions of confirmed cases and deaths worldwide.¹ During the COVID-19 epidemic, medical institutions should not only meet the basic medical needs of residents, but also carry out medical treatment for patients

infected with COVID-19. The risk of nosocomial infection has greatly increased, and nosocomial infection control has become a medical focus and research hotspot.² Since the outbreak of COVID-19, our hospital, as a key unit of disease diagnosis and treatment, has also needed to ensure the daily diagnosis and treatment activities³ while doing well in the daily epidemic prevention and control. Therefore, how to actively carry out epidemic prevention and control work has become a hot topic of current research. As one of the main forces of COVID-19 prevention and control, in addition to daily outpatient and emergency care, nurses also undertake isolation guarantee, nucleic acid collection, antibody collection, and vaccination for overseas returnees. Almost all nurses may rotate to the frontline of epidemic prevention and control.^{4,5} Since COVID-19 is a major infectious disease, nurses lack the core emergency response capacity for such diseases, which makes nursing work more difficult. Based on the background mentioned above, how to improve the ability of all nurses to handle infectious disease emergencies has become the popular direction of research.^{6,7} Competency-

based education (CBE) is a kind of education thought, and education mode, and its theory is to engage in a specific career necessary ability starting point and determine the target, design training structure, training methods, and teaching effect evaluation index. CBE determines the goal, designs the training structure, the training method, and the teaching effect evaluation index according to the ability necessary for a specific career.^{8,9} CBE has been widely used in general surgery,¹⁰ anesthesiology residency,¹¹ and managing chronic disease.¹² However, the effectiveness of the training of nosocomial infection control specialist nurses under the background of the new crown epidemic based on competence-based theory (CBT) remains unclear.

Therefore, our study aimed to explore the effectiveness of the training of nosocomial infection control specialist nurses under the background of the new crown epidemic based on CBT. Our study might provide a clinical reference for nursing practices, and can improve the level patient care, and improve the overall healthcare outcomes during pandemic situations.

MATERIALS AND METHODS

Clinical materials

A total of 84 nurses containing 5 men and 79 women who could actively participate in the training were selected by recommendation of every department from June 2020 to June 2021, were chosen as study subjects, with age (22-53), average age (of 35.79 ± 6.71), clinical working year (1-16) and average clinical working year (6.19 ± 0.51), including 5 graduates, 70 undergraduates, 9 junior college students for educational background, and 1 deputy chief nurse, 42 supervisor nurse and 41 nurses. All nurses signed an informed consent form for this study.

Inclusion and exclusion criteria

Inclusion criteria: (1) All nurses were key nurses recommended by certain departments of our hospital and could actively participate in the training. (2) All nurses were aware of the purpose and method of the training and could actively participate. (3) All nurses could participate in the assessment after training.

Exclusion criteria: (1) Nurses going out for other studies during training or participating in other experiments. (2) Nurses in pregnancy or lactation.

Methods

All nurses underwent systematic and standardized training. Under the background of the new crown epidemic based on CBT, nurses had professional quality control knowledge, clinical practice, and techniques of management, coordination, teaching, and guidance, undertook the infection management and teaching work of the department, and were responsible for the epidemic prevention and control in their own department. The specific training methods were as follows: (1) Nurses' current ability to respond to infectious disease emergencies and their training

needs. Before the training, the "Core Emergency Ability Questionnaire of Medical Personnel for Major Infectious Diseases" compiled by Liu Lingyu et al.¹³ was used to investigate the infectious disease emergency ability of the nurses participating in the training and to confirm whether the nurses had participated in such training, their current education, and whether they had the experience in nursing work for infectious diseases. Training programs were specified according to the survey results. At the same time, during the training process, the nurses were taught online of the theory part and taught by video of the operation part, combined with the on-site drills of emergency skills. (2) The training mode was designed based on CBT. (1) Focus group meeting. Relevant experts from the nursing department, medical department, nosocomial infection control department, and others were called in to determine the purpose, methods, and forms of the training. (2) takes CBT as the theoretical basis, according to the training purpose, the core emergency capability as the standard, takes the survey results in (1) as the training focus, constructs the corresponding training strategy, formulates detailed training contents and methods, and fully considers the feasibility and effectiveness of the training method. With CBT as the theoretical basis, according to the training purpose, with the core emergency capability as the standard, the survey results in (1) as the focus, the corresponding training strategies and detailed training contents and methods were formulated, and the feasibility and effectiveness of the training methods were fully considered. (3) Teaching training. Through diversified training and assessment, Wechat group and Tencent meetings were used to assist everyone in completing the theoretical courses and scenario simulation training. Teaching videos such as wearing and taking off protective clothing and throat swab sampling were shot to carry out training more intuitively and quickly. (4) Contingency plan for COVID-19 infection was developed. Simulation exercises for outpatient, emergency, ward, and special departments were strengthened, with the management for suspected cases focused. COVID-19 training for all nurses was operated from individuals to the whole point. The infection specialist nurses who passed the examination could serve as the training teachers of their departments and guide the department to complete the training and assessment of the nurses. After 6 months of the intervention, the effect of the training was evaluated. All these training methods could improve the awareness of nurses to prevent nosocomial infection and strengthen their emergency response ability.

Outcome measures

Core competence and job fit. Before and after 6 months of training, the Competency Inventory for Registered Nurses (CIRN) was used to evaluate the nurse core competence from seven dimensions: judging thinking and scientific research, clinical nursing, leadership ability, ethics and legal practice, interpersonal relationship, professional development, and educational consultation. The total score is 232, with the

higher score indicating the stronger core competence.^{14,15} The Nurse Job Fit Scale was used to evaluate nurses' competency from the perspective of professional knowledge, professional technology, comprehensive quality, and professional ability. The scale has 77 items, with a higher score indicating the better post-competency.¹⁶

Core emergency response for major infectious diseases. Before and after 6 months of training, nurses were evaluated about the relevant matters needing attention (international rescue, bioterrorist attacks, and infectious disease emergencies after natural disasters), and all these relevant matters are all public emergencies, which can better reflect the emergency capacity of nurses, filling in the People's Republic of China Infectious Disease Report Card and the scope of reporting infectious disease emergencies. Each item has 5 scores, with the higher the score, the stronger the emergency ability.¹⁷

Satisfaction degree. After 6 months of training, the nurses assessed their satisfaction with the course setting, training content, training duration, training form and assessment form. The results of the questionnaire were divided into very satisfied, satisfied, mild, dissatisfied, and very dissatisfied.¹⁸

Statistical analysis

SPSS 24.0 software (IBM Corporation, Chicago, IL, USA) was used for data processing; counting data were tested by line χ^2 test and expressed as (n, %). Variables data were tested by *t* test and expressed as ($\bar{x} \pm s$). $P < .05$ indicated a statistically significant difference.

RESULTS

Comparison of core competence and job fit of nurses

No significant difference was observed in leadership ability and interpersonal relationships before and after training, with no statistical significance ($P = .342$ and $P = .569$). Six months after training, the scores were higher in judging thinking and scientific research, clinical nursing, ethics and legal practice, professional development, educational consultation, professional knowledge, professional technology, comprehensive quality, and professional ability, with statistical significance ($P = .000$). These results are detailed in Table 1. It was suggested that training of nosocomial infection control specialist nurses under the background of the new crown epidemic based on competence-based theory could improve the core competence and job fit of nurses, in order to better provide nursing for patients.

Comparison of core emergency response for major infectious diseases before and after training

The core emergency response of nurses for major infectious diseases was strengthened after the training. After six weeks of training, the scores in relevant matters needing attention (international rescue, bioterrorist attacks, and infectious disease emergencies after natural disasters), filling in People's Republic of China Infectious Disease Report

Table 1. Comparison of core competence and job fit of nurses (point, $\bar{x} \pm s$)

		Six months after	Before	<i>t</i>	<i>P</i> value
Core competence	judging thinking and scientific research	34.39±3.41	29.58±3.22	9.413	.000
	clinical nursing	30.11±2.98	25.69±2.56	11.353	.000
	leadership ability	27.42±3.24	27.31±3.21	0.391	.342
	ethics and legal practice	25.98±3.41	23.29±3.21	12.195	.000
	interpersonal relationship	26.79±3.29	26.76±3.25	1.283	.569
	professional development	20.85±4.31	17.58±3.86	8.434	.000
Job fit	educational consultation	23.43±3.15	20.52±3.01	7.892	.000
	professional knowledge	72.59±5.32	67.41±4.98	4.591	.000
	professional technology	93.41±6.98	85.45±5.12	8.375	.000
	comprehensive quality	45.39±4.34	40.12±4.21	7.715	.000
	professional ability	55.69±5.53	47.63±4.98	10.693	.000

Table 2. Comparison of core emergency response for major infectious diseases before and after training (point, $\bar{x} \pm s$)

Core emergency response for major infectious diseases	Before	After	<i>t</i>	<i>P</i> value
International rescue	4.65±0.99	3.14±0.94	7.491	.000
Bioterrorist attacks	4.56±0.98	3.17±0.92	6.435	.000
Filling in People's Republic of China Infectious Disease Report Card	4.62±0.94	3.21±0.86	9.291	.000
Infectious disease emergencies after natural disasters	4.59±0.89	3.26±0.88	6.671	.000
Scope of reporting infectious disease emergencies	4.60±0.93	3.29±0.81	8.698	.000

Table 3. Satisfaction from trainee nurses (n, %)

Item	Very satisfied	Satisfied	Mild	Dissatisfied	Very dissatisfied
Curriculum setting	84 (100.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Training content	76 (90.48%)	8 (9.52%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Training duration	78 (92.86%)	6 (7.14%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Training form	77 (91.67%)	7 (8.33%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Assessment form	84 (100.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)

Card, and the scope of reporting infectious disease emergencies were all higher than before, with statistical significance ($P = .000$). These results are detailed in Table 2. Improving nurses' core emergency responsibility for major infectious diseases could better respond to hospital emergencies in the context of the COVID-19 epidemic.

Satisfaction from Trainee Nurses

All nurses rated their satisfaction after 6 months of training. The results showed that they had high satisfaction with curriculum setting and assessment form, with satisfaction of 100.0%, followed by training duration, with satisfaction of 92.86%, as shown in Table 3. The high satisfaction of nurses could promote the implementation of training plan.

DISCUSSION

Since December 2019, COVID-19 has occurred swept the world. As a key unit of disease diagnosis and treatment, our hospital has played an important role in epidemic prevention and control. Nosocomial infection has become the primary issue threatening the lives of healthcare workers and patients.¹⁹ Studies from domestic scholars showed that²⁰ nosocomial infection has many influencing factors, among which the unreasonable operation of nurses accounts for 30.0%-50.0%. Therefore, under the novel coronavirus epidemic, strengthening the professional skill training of nurses is of great significance in reducing the nosocomial infection rate.

In recent years, the training of nosocomial infection control specialist nurses for COVID-19 based on CBT has

been applied, with ideal effect.²¹ The scores in critical thinking and scientific research, clinical nursing, ethics and legal practice, professional development, education consulting and professional knowledge, professional skills, comprehensive quality, and professional ability of nurses after 6 months of training were higher than those before, which was consistent with previous study.²² It also showed that the training of specialist nurses increased their core competence and job fit, which could better provide nursing for patients and prevent nosocomial infection. CBT is an educational theory and educational mode. CBT according to the needs of job groups, level by level to determine the ability to engage in the industry should have, clear training objectives. Then, the school organizes relevant teaching staff to set up courses and organize teaching content with these abilities as the goal, and finally assess whether these abilities are met.²³ Under the special background of COVID-19, this theory can determine the training objectives, design the training content according to the deficiencies and problems of nurses in dealing with large public health events, and select the training method based on individuals.^{24,25} Therefore, the core of CBT is to determine the competency goals based on the job needs and to expand accordingly to obtain the corresponding competency. Meanwhile, the training of nosocomial infection control specialist nurses for COVID-19 based on CBT quickly builds a team of infection control specialist nurses. It can popularize this training and assessment from individuals to the whole point.²⁶ The training gives full play to the advantages of the network, uses the nursing assistant APP and Tencent meeting to complete the online teaching, and puts the shot operation video into the nurses' mobile phone, which helps to improve the core emergency response of nurses for major infectious diseases.²⁷ In the special context of the novel coronavirus epidemic, reducing personnel contact can effectively prevent cross-infection, and traditional on-site training cannot be effectively implemented. The use of the network, nurse APP and Tencent can make the training of nurses not limited by region and time, nurses can view the training content at any time.²⁸ The emergency consciousness, emergency ability and application of emergency plan of nurses directly affect the emergency effect of hospital nursing team. After six weeks of training, the scores in relevant matters needing attention (international rescue, bioterrorist attacks, and infectious disease emergencies after natural disasters), filling in the People's Republic of China Infectious Disease Report Card, and the scope of reporting infectious disease emergencies were all higher than before. As suggested from the results of our study, the training of nosocomial infection control specialist nurses for COVID-19 based on CBT helped to improve their core emergency response for major infectious diseases, contributing to the calmness in the face of COVID-19. Consistently, it has been documented that CBE can improve the knowledge and skills nurses.²⁹ The results showed that the trainee nurses had high satisfaction with the curriculum setting and assessment form, with satisfaction of

100.0%, followed by training duration, with satisfaction of 92.86%, suggesting that the nurses participating in the training were relatively satisfied with the training, which helped to improve the training quality and nurses could better take effective measures to prevent nosocomial infections. In line with our findings, it has been reported that CBE can improve students' application ability and satisfaction in undergraduate radiology education.³⁰

There are some limitations to our study. First, the sample size was small. Second, the study was conducted at a single site. All these limitations may influence the accuracy and scope of application. Therefore, future large-scale, multi-site and long-term studies should be conducted to evaluate the effectiveness of the training.

In conclusion, the training of nosocomial infection control specialist nurses for COVID-19 based on CBT could improve their core competency, job fit, and emergency responses for major infectious diseases, with high satisfaction, which is worthy of popularization. Our study might provide a clinical reference for nursing practices, and can improve the level patient care, and improve the overall healthcare outcomes during pandemic situations.

FUNDING

This work was supported by the Academic Leaders Training Program of Pudong Health Bureau of Shanghai (No. PWRD2021-19).

REFERENCES

1. Safiabad T, Shi SH, LeBlanc JJ, Sadiq Z, et al. Tools and Techniques for Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)/COVID-19 Detection. *Clin Microbiol Rev*. 2021;34(3):e00228-20. doi:10.1128/CMR.00228-20
2. Bardi T, Pintado V, Gomez-Rojas M, et al. Nosocomial infections associated to COVID-19 in the intensive care unit: clinical characteristics and outcome. *Eur J Clin Microbiol Infect Dis*. 2021;40(3):495-502. doi:10.1007/s10096-020-04142-w
3. Zhao L, Wang B, Duan LJ. Research on the application of multidisciplinary linkage teaching based on "Internet+" and SP in the training of intravenous therapy specialized nurses. *Chin J Med Edu Res*. 2021;20(07):837-840.
4. Sun YJ, Qin BH, He Y. Altruistic Behavior of Medical Staff based on the Theory of Planned Behavior in Epi-demic Prevention and Control. *Chinese Journal of Social Medicine*. 2020;37(451-455).
5. Margadant C, Wortel S, Hoogendoorn M, et al. The Nursing Activities Score Per Nurse Ratio Is Associated With In-Hospital Mortality, Whereas the Patients Per Nurse Ratio Is Not. *Crit Care Med*. 2020;48(1):3-9. doi:10.1097/CCM.0000000000004005
6. Zhao HT, Zhang GL, Guo SL. Strategies based on research information platform to improve emergency response capacity of scientific research management in a municipal hospital under COVID-19 epidemic situation. *Journal of Clinical and Experimental Medicine*. 2020;19(10):4.
7. Zhang H, Shen HL, Xia L. Construction of COVID-19 Epidemic Prevention and Control Capacity Based on Big Data Perspective. *Acta Math Appl Sin*. 2020;43(2):14.
8. Gao XL, Pang GF, Zhou HF. Study on the Effect of Standardized Training Mode for New Recruits Nurses Based on Clinical Practice Ability. *Zhongguo Yaowu Yu Linchuang*. 2019;19(10):3.
9. Suzuki K, Ohshimo S, Shime N. Confounding factors for the effect of misdiagnosis of site of infection on in-hospital mortality. *Crit Care*. 2019;23(1):294. doi:10.1186/s13054-019-2577-4
10. Gauvin G, Hay K, Hopman W, et al. Competency-based education in general surgery: are Canadian residents ready? *Can J Surg*. 2021;64(5):E473-E475. doi:10.1503/cjs.011520
11. Fuller SL, Ambardekar AP, Diachun CAB, et al. Competency-Based Time-Variable Anesthesiology Residency Training: Identification of Problems and Solutions. *Anesth Analg*. 2023.
12. Glasgow NJ, Wells R, Butler J, Gear A. The effectiveness of competency-based education in equipping primary health care workers to manage chronic disease in Australian general practice settings. *Med J Aust*. 2008;188(8):S92-S96. doi:10.5694/j.1326-5377.2008.tb01755.x
13. Liu LY, Zhang BZ, Yang Z, Tang LP, Gui L. Investigation on Medical Workers' Core Emergency Response Competences in Epidemics of Infectious Diseases. *J Nurs Sci*. 2019;34(005):75-77.
14. Pei Q, Zhang NN, Li WD, Li T. Construction of Evaluation System for Training Effect of Enterostomy Specialist Nurses Based on Koch Model. *Xinjiang Yike Daxue Xuebao*. 2020;43(7):4.
15. Haugnes H, Elstrom P, Kacelnik O, Jadcak U, Wisloff T, de Blasio BF. Financial and temporal costs of patient isolation in Norwegian hospitals. *J Hosp Infect*. 2020;104(3):269-275. doi:10.1016/j.jhin.2019.11.012
16. Wei XX, Xu YF, Wang CL, Deng YB, Fu Y, Du QF. Research on the Emergency Management of the Grid Management of Medical Personnel in the Medical Community during the COVID-19 Epidemic Based on Wuli-Shili-Reli Methodology. *Chinese Journal of General Practice*. 2020;18(11):5.
17. Zeng Z, Zhang Y, Jiang W, He L, Qu H. Modulation of autophagy in traumatic brain injury. *J Cell Physiol*. 2020;235(3):1973-1985. doi:10.1002/jcp.29173
18. Ren HX, Ning SS, Kang N, et al. Investigation and Analysis of Trust in the Nurse-patient Relationship under COVID-19: Based on the Perspective of Mixed Research Method. *Chinese Medical Ethics*. 2020;33(10):7.
19. Xu JJ. Responses to COVID-19 and Challenges to Large-scale Online Learning for Global Education System: Findings and Insights Based on Results from OECD Survey across Nations. *International and Comparative Education*. 2020;42(6):8.

20. Wang MQ, Tang XH, Peng JH, Sheng J, Tang MD, Deng H. Application of nursing clinical ladder program based on Benner theory in nurses, stratified training. *Chin J Prac Nurs*. 2019;35(2):5.
21. Jansson MM, Syrjälä HP, Ala-Kokko TI. Association of nurse staffing and nursing workload with ventilator-associated pneumonia and mortality: a prospective, single-center cohort study. *J Hosp Infect*. 2019;101(3):257-263. doi:10.1016/j.jhin.2018.12.001
22. Dury C. [A competency-based approach for nursing care instruction. Analysis of teaching practices]. *Rech Soins Infirm*. 2003;(73):4-40. Une approche par les compétences pour l'apprentissage des soins infirmiers. Analyse des pratiques des enseignants. doi:10.3917/rsi.073.0004
23. Chen L, Xu Y, Li F, et al. Developing the theoretical model of Chinese physical education teachers' health communication competence: based on grounded theory. *Front Public Health*. 2023;11:1233738. doi:10.3389/fpubh.2023.1233738
24. Liang SS, Zhu JY, Xing H, Zha QH, Chen HY. Curriculum design of the core courses for PICC specialized nurses. *Shanghai Nursing*. 2019;19(3):3.
25. Liu Y, Yu MF, Zhang WY. Study on the Application and Effect of On-the-job Training for Nurses Based on ADDIE Model. *J Nurs (Luton)*. 2019;26(15):4.
26. Tarazi WW. Associations between Medicaid expansion and nurse staffing ratios and hospital readmissions. *Health Serv Res*. 2020;55(3):375-382. doi:10.1111/1475-6773.13273
27. Zhao XH, Zhao GX, Shi BY, Jin G. Application of the combination teaching modal of observation-teaching-discussion(OTD) and case instruction in nutritional nurse training. *Journal of Qilu Nursing*. 2019;25(12):4.
28. Hartley D, Ridenour M, Craine J, Morrill A. Workplace violence prevention for nurses on-line course: program development. *Work*. 2015;51(1):79-89. doi:10.3233/WOR-141891
29. Chan TE, Lockhart JS, Thomas A, Kronk R, Schreiber JB. An integrative review of nurse practitioner practice and its relationship to the core competencies. *J Prof Nurs*. 2020;36(4):189-199. doi:10.1016/j.profnurs.2019.11.003
30. Qin Y, Huang Z, Yu J, et al. Practice-Based Learning Using Smart Class: A Competency-Based Model in Undergraduate Radiology Education. *Acad Radiol*. 2022;29(1):150-157. doi:10.1016/j.acra.2020.09.028